

## Density Determination

Chemistry is the study of matter, which is defined as anything that has mass and volume. In this experiment you will measure the volumes of different materials using two different methods. You will also measure the mass of these materials. You will use the relationship between mass and volume to find the density of the materials.

### Purpose

Learn and practice techniques and calculations for determining volume and density of a substance.

### Equipment

balance  
ruler  
graduated cylinders

beakers  
goggles

### Materials

distilled water  
regularly shaped metal object  
metal pellets

unknown liquids  
2 irregularly shaped solids  
section of glass rod

### Procedure

#### Part 1. Solids

1. Measure and record the dimensions of the glass rod (diameter and length).
2. Measure and record the mass of the glass rod.
3. Find and record the volume of the glass rod using the water displacement method. **Tip:** Remember to use the smallest graduated cylinder that the object fits in.
4. Measure and record the mass of the rock.
5. Find and record the volume of the rock using the water displacement method. **Tip:** Remember to use the smallest graduated cylinder that the object fits in.
6. Measure and record the mass of the rubber stopper.
7. Find and record the volume of the rubber stopper using the water displacement method. **Tip:** Remember to use the smallest graduated cylinder that the object fits in.
8. Measure and record the dimensions of the metal cylinder (diameter and length).
9. Measure and record the mass of the metal cylinder.
10. Find and record the volume of the metal cylinder using the water displacement method. **Tip:** Remember to use the smallest graduated cylinder that the object fits in.
11. Measure and record the mass of the cup of metal pellets. Be sure to subtract the mass of the cup from this measurement.
12. Find and record the volume of the metal pellets using the water displacement method. **Tip:** Remember to use the smallest graduated cylinder that the object fits in.

## Part 2. Liquids

13. Measure and record the mass of a clean dry 10 mL graduated cylinder.
14. Add exactly 10.0 mL of distilled water to the cylinder.
15. Measure and record the combined mass of the cylinder and the water. **Return the water to the container.** Clean and dry the cylinder.
16. Repeat steps 13-15 for the two unknown liquids.

**Questions and Conclusions.** Questions must be answered in complete sentences on a separate sheet of paper. Complete the **Data Table** and **Calculations** pages before beginning the questions and conclusions.

1. Compare the value of the volume of the glass rod calculated from its dimensions to that attained by measuring its water displacement. Make the same comparison for the values attained by these two methods for the volume of the regularly shaped metal object.
2. Of the two methods used to determine the volume of a solid, which is more accurate? Explain your answer.
3. From your observations and data, are the metal object and the metal pellets composed of the same metal? Give evidence to support your answer.
4. The density of glass ranges from 2.4 to 2.8 g/cm<sup>3</sup>. The density of distilled water at 20°C is approximately 1.0 g/mL. Compare your experimental results with these values. What errors might account for differences between your results and these accepted values?
5. Why is it necessary to indicate temperature when giving density values of liquids?
6. The table below lists the densities for several different substances. (Liquids are at 20°C.) Using this table and your data, try to identify the following:
  - a. composition of the regularly shaped metal object
  - b. composition of the metal pellets
  - c. unknown liquid A
  - d. unknown liquid B

Sample	Density
Lead	11.34 g/cm <sup>3</sup>
Copper	8.93 g/cm <sup>3</sup>
Tin	7.31 g/cm <sup>3</sup>
Aluminum	2.70 g/cm <sup>3</sup>
Ethanol	0.79 g/mL
Vegetable oil	0.92 g/mL
Ethylene glycol	1.11 g/mL
Glycerine	1.25 g/mL

Name \_\_\_\_\_

Date \_\_\_\_\_

Density Lab Data Table

Density Lab Data Table										
Solid Object	Mass	Dimensions	Calculated Volume (Show work in box)		Initial Volume	Final Volume	Volume By Water Displacement (Show work in box)		Density with Volume by Dimensions (Show work in box)	Density with Volume by Water Displacement (Show work in box)
Glass Rod		Length =  Diameter =								
Rock										
Rubber Stopper										
Metal Cylinder		Length =  Diameter =								
Metal Pellets										
Liquid	Mass of Empty Graduated Cylinder	Mass of Graduated Cylinder with 10 mL of Liquid	Mass of 10 mL of Liquid (Show work in box)		Volume of Liquid		Density of Liquid (Show work in box)	Answer the questions on the back of this data table		
Distilled Water										
Liquid A										
Liquid B										

Answer the questions on the back of this data table